1-1-2010

A Comparison Of Computer-Assisted And Peer-Partner Practice In Treble-Staff Note Recognition

Pammala K. Goodenough
Eastern Illinois University

THESIS MAINTENANCE AND REPRODUCTION CERTIFICATE

TO: Graduate Degree Candidates (who have written formal theses)

SUBJECT: Permission to Reproduce Theses

The University Library is receiving a number of request from other institutions asking permission to reproduce dissertations for inclusion in their library holdings. Although no copyright laws are involved, we feel that professional courtesy demands that permission be obtained from the author before we allow these to be copied.

PLEASE SIGN ONE OF THE FOLLOWING STATEMENTS:

Booth Library of Eastern Illinois University has my permission to lend my thesis to a reputable college or university for the purpose of copying it for inclusion in that institution's library or research holdings.

Pamala K. Goodenough May 11, 2010

Author's Signature Date

I respectfully request Booth Library of Eastern Illinois University **NOT** allow my thesis to be reproduced because:

_____

_____

_____

_____ _____

Author's Signature Date

This form must be submitted in duplicate.

A Comparison of Computer-Assisted and Peer-Partner Practice in Treble-Staff Note Recognition

(TITLE)

BY

Pammala K. Goodenough

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Master of Arts in Music

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

2010

YEAR

I HEREBY RECOMMEND THAT THIS THESIS BE ACCEPTED AS FULFILLING
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

Patricia L. Poulter 4/29/2010

THESIS COMMITTEE CHAIR — DATE

Jerry L. Daniels 4/29/10

DEPARTMENT/SCHOOL CHAIR OR CHAIR'S DESIGNEE — DATE

Gary Jenson 4/29/2010

THESIS COMMITTEE MEMBER — DATE

THESIS COMMITTEE MEMBER — DATE

Peter Hesterman 4/29/10

THESIS COMMITTEE MEMBER — DATE

THESIS COMMITTEE MEMBER — DATE

A Comparison of Computer-Assisted and Peer-Partner Practice in Treble-Staff Note Recognition

Pammala K. Goodenough

Eastern Illinois University

May 2010

Abstract

This study compared the effectiveness of computer-assisted practice and peer-partner practice in treble-staff note recognition. Six 3rd-grade classes participated in 3 sessions, each including a 2-minute pre-test, a lesson on treble staff notes, a 10-minute practice drill, and a 2-minute post-test. During practice, half the students used the online *Note Trainer* from *Ricci Adams' Musictheory.net* to practice identifying notes, while the other half practiced with a partner using flashcards of the notes of the treble staff. Results showed the computer students averaged over twice as many correct answers as the peer practice group at the end of the first session. The peer groups began to catch up in subsequent sessions, but the computer group still scored over 30% better than the peer group at the end of the third session. Computer practice was especially effective in a bilingual class, where the computer students outscored the peer group after 3 sessions by 178%.

Acknowledgements

I am indebted to my Thesis Chair, Dr. Patricia Poulter, for being my advocate throughout this thesis project and Masters' program. Her encouragement, wise counsel, and love for music education have continually inspired me in my quest for excellence in teaching. Graduate Advisor Dr. Jonathan Kirk and committee members Dr. Peter Hesterman and Dr. Gary Jensen have been most gracious and helpful in accommodating the completion of my degree by long distance.

I am very grateful for the time and advice of Dr. Amy Simmons of The University of Texas at San Antonio, who was kind enough to allow me to take Psychology of Music Education as a guest student at UTSA. Her expertise in making research accessible and enjoyable made this project possible. My brother-in-law, Dr. Don Ratcliffe, also provided invaluable guidance on the logistics of the study as well as data analysis.

I could not have completed this thesis and degree program without the years of encouragement, support, and love of my husband, Tim, and my grown children. Last, but not least, I am thankful for all the practical help given the last three months by my mother, Nancy Hogue, who is my greatest inspiration.

Table of Contents

List of Tables

A Comparison of Computer-Assisted and Peer-Partner Practice in Treble-Staff Note Recognition

Elementary music teachers have the responsibility of teaching their students the National Standards for Music Education (see Appendix A) (Consortium of National Arts Education Associations, 1994). These standards work together to develop the student into a lifelong musician or at the least an informed lifelong music consumer. Covering all of the standards is a daunting task in itself, but it becomes an even greater challenge when faced with the time constraints given to the elementary music teacher.

In the ideal music classroom, elementary students would receive at least 90 minutes of general music instruction per week, divided into 20–30 minute periods for grades one and two, and 25–45 minute periods for grades three through six (Consortium of National Arts Education Associations, 1995). According to *The Texas School Music Program*, a basic program includes at least two periods per week for a total of no fewer than 60 minutes. A quality program would include three periods weekly for a total of 75–150 minutes (Texas Music Administrators Conference, 2005). The reality is that few schools are able to meet those recommendations. In my current teaching assignment in a highly-reputable school district, I see each music class for just 45 minutes every sixth school day. Adding in the weekends, eight to ten days pass between music classes, and students are seen less than thirty times during the school year. Careful planning is necessary to ensure that all-important concepts are included.

With such a time lapse between classes, presenting musical concepts must include time for student practice of those concepts. As time is at a premium, it is important to find the most efficient method for practice. Computer-assisted practice and peer-partner

practice with flashcards are two methods by which students can reinforce the learning acquired in the music classroom. This study compares the effectiveness of these two methods with third-grade students as they practice concepts from Standard Five, specifically, learning to read pitch notes on the treble staff (Consortium of National Arts Education Associations, 1994).

Literature Review

Flashcards

Reading a musical score is not unlike the skill of reading books. Music reading depends on individual note recognition just as reading at its basic level involves letter and word recognition. One of the goals in the music class is to increase the speed of the note recognition, to make way for the actual playing or singing of that note. While research findings on the use of flashcards in music reading are scarce, there are studies on the effect of flashcards in the general reading classroom.

Flashcards have been found to be useful in increasing the speed of word recognition, which then leads to better comprehension in poor readers (Tan & Nicholson, 1997). Reading involves many skills at once, so to make them become automatic, some of them need to be "overlearned." In continued study, Tom Nicholson (1998) found when students had success in just one skill of reading (identifying words), they acquired confidence in their efforts to improve their reading (Nicholson, 1998).

Karen Fuson and Kathleen Brinko (1985) compared the use of flashcards versus computer drill for learning basic math facts. Their study lasted for 6 weeks, drilling four days out of the week, and then taking a progress test on the fifth day. There was learning in the first two weeks, but the third and fourth weeks showed little or no learning. The

groups traded activities the fifth week, and some learning was observed which was attributed to the novelty of the new activity. Overall, both methods produced equivalent learning (Fuson & Brinko, 1985).

Computer-Assisted Instruction

Computer technology has been shown to improve how and what children learn, as reported in an article by Roschelle, Pea, Hoadley, Gordin and Means (2000). They examined 21 major studies from 1989–1999, including some meta-analyses. The studies covered a wide range of ages, abilities and academic subjects. Most of the studies resulted in improvement in student performance attributed to the use of computer technology (Roschelle, Pea, Hoadley, Gordin, & Means, 2000). Computer use in a first-grade reading classroom was found to have a significant effect on the students' vocabulary development, yielding a much larger gain than in the control group of students who had been taught by the direct teaching method (Boling, Martin, & Martin, 2002).

Computer-Assisted Instruction (CAI) software in music has been used for learning and practicing music theory concepts since the late 1960s. Due to the high cost of equipment, this first generation of CAI was limited to colleges and universities where the hardware was already in place. A second generation came about in the late 1970s, when personal home computers became available. In the early 1980s, a standardized language for computers and synthesizers was created (Musical Instrument Digital Interface, or MIDI), influencing the third generation of CAI in music. Fourth generation software was improved with enhanced graphics, improved sound, and faster processing. Finally, a fifth generation appeared on the Internet, where CAI music programs became

available online (Peters, 1992). David Beckstead (2001) sees this technology both as a tool of efficiency and as a tool of transformation for music education (Beckstead, 2001).

While there are many articles on the use of computers in music education, there are very few studies specifically measuring the effect of computer study on music reading skills. A study by Willett and Netusil (1989) examined the effectiveness of computer drill versus classroom instruction while learning bass clef notes. Software called *Clef Notes* was used, and results showed that the computer students scored significantly higher than the students drilled by the teacher in the classroom setting. An interesting observation was that while the computer might seem impersonal, a student might actually see it as being more personal. A computer can give its undivided attention to the student while the teacher's attention is divided among the students in the classroom. Other advantages to the computer instruction are the infinite patience of the computer and the control the student is allowed to have (Willett & Netusil, 1989).

Computer-aided collaborative learning was observed to be a positive experience in a harmony class at the New England Conservatory of Music. Contrasted with the passive classroom environment, the students interacted in discussions in the computer lab, sharing in decision making and problem solving (Hoffman, 1991).

Peer Tutoring

Peer tutoring generally does not involve the actual presenting of new material by the student tutor. In the following studies, peer tutoring refers to the help given by students with the practice of concepts already learned. In the *ClassWide Peer Tutoring (CWPT) model*, tutoring often occurs as reciprocal pair practice, each student taking turns as the tutor and the tutee.

The benefits of peer tutoring were demonstrated in a longitudinal study by Greenwood, Delquadri, and Hali (1989). Over a period of four years, in addition to the classroom teaching, a group of students used the *CWPT* method while the control group received only teacher instruction. Students involved in the peer tutoring produced significantly greater gains in test scores than did the control group (Greenwood, Delquadri, & Hall, 1989).

CWPT allows teachers to use the same method of instruction for all students while differentiating ability level. A study of third graders over six weeks found that students using *CWPT* experienced substantial gains in spelling test scores, with the greatest gain percentage coming from students who were at-risk learners (King-Sears & Bradley, 1995).

Another study on *CWPT* methodology in the reading classroom tested its effectiveness with low achievers (with and without disabilities) and average achievers. After 15 weeks, students in peer tutoring classes saw greater reading progress than those in the non-tutoring classes, regardless of their achiever status (Fuchs, Fuchs, Mathes, & Simmons, 1997).

Alexander and Dorow (1983) examined the effects of peer tutoring on the music performance of both the tutors and the tutees in a beginning band class. In one experiment, they found both tutors and tutees performing substantially better on post-tests than those who had the traditional band instruction (Alexander & Dorow, 1983). Darrow, Gibbs, and Wedel (2005) studied the effectiveness of *CWPT* in the elementary music classroom. In this study, the students followed the *CWPT* model as reciprocal tutors, where each took turns being the tutor. The findings showed that peer tutoring was

effective in learning key signatures, and tutoring produced simultaneous learning. There was no comparison made in this study between the peer tutoring and any other type of practice (Darrow, Gibbs, & Wedel, 2005).

Computer-Assisted vs. Peer-Partner

Morgan Carlyle (2006) compared computer instruction software to peer tutoring with second-grade reading students and found increases in skill in both groups, as well as the control group. There was no significant difference between the methods used, which lead to the conclusion that the practice itself, not the methodology, was responsible for the increase (Carlyle, 2006).

There is general consensus that both computer-assisted instruction and peer tutoring are effective methods for enhancing learning in the classroom. However, there has been little study comparing the effectiveness of computer-assisted practice versus peer-tutoring practice in the elementary classroom, let alone the elementary music classroom.

I want my students to experience the confidence in identifying music notes that the Nicholson study (1998) observed in students who used flashcards for learning to identify words. The lack of information comparing computer-assisted practice to peer tutoring with flashcards motivated this study. I compared the scores of pre-tests and post-tests of students who practiced identifying notes on the treble clef using a computer to the scores of students who practiced their notes using flashcards in a reciprocal peer-tutoring setting.

Methodology

School Demographics

The study was completed with all third graders in a suburban elementary school of 740 students. Demographics for the grade level are listed below in Table 1.

Table 1
Demographics of Study Population

Total: 114 third grade students	
Female	65%
Male	35%
Hispanic	52%
White	28%
Black	16%
Special Education	< 1%
Economically Disadvantaged	31%
Limited English Proficiency	15%

The grade level is divided into six different classes, ranging from 18–21 students in each class. One class with 83% of its students having limited English proficiency uses bilingual instruction in English and Spanish. Music classes are taught in English as an important component of their language learning, but I do use Spanish in my classroom when it is critical for clear understanding of instructions or concepts.

Pilot Study

A pilot study was conducted with two classes of fourth graders. Many students in these fourth-grade classes already had some prior experience with note reading, so I did not compare the scores from these sessions. The purposes for the pilot were to practice presenting the teaching portion of the lesson and to work out procedural details. Teaching the lesson twice to fourth-grade classes allowed for time to revise and re-teach the lesson to ensure uniformity of presentation to all third-grade classes.

While I had originally planned to do the whole session in the computer lab, the

staff board in the music room was better than a plain white board for the direct instruction portion of the lesson. After the pre-test and lesson, we went to the computer lab (just two doors down from the music room) for their computer or peer practice, returning to the music room for the post-test. I also found the best procedure was to have a clipboard with all the materials already on their chairs to increase efficiency and reduce student distraction.

One final benefit to running a pilot was discovering that it really bothered those students who did not know their notes to leave the spaces blank, especially in the pre-test. By telling the students to put a question mark in the blank if they did not know that particular note yet, all students were writing something during the tests, and no one felt embarrassed because they had few or no answers.

Materials

Materials used in this study included (a) author-created pre-tests and post-tests; (b) clipboards with pencils; (c) a timer; (d) a whiteboard with a three-inch staff and markers; (e) author-created flashcards; and (f) a computer lab with Internet accessibility.

The pre-tests and post-tests were created with the notation program, *Sibelius 5* (see Appendix B). All tests used the same format, but every test had a different note order. Each line and space note was represented every nine notes to ensure that even if a student only answered the first nine notes, all the material would be covered. There were 27 notes on each side of the page for a total of 54 notes.

The pre-test and post-tests were attached to clipboards. Pencils were attached to the clipboards with hook-and-loop tape, so all students could easily find their pencils, and pick them up at the same time. This also provided a specific place for students to place

their pencils when time was called. A digital timer was used to time the tests as well as the practice time. A 12-foot white board with a six-foot long permanent staff was used for the lesson portion of each session. Students sat on a rug in front of the board during the lesson.

The flash cards used by the peer partners were created using the software, *Sibelius 5* (see Appendix C). They measured four inches by five inches in landscape orientation. The computer practice program used whole notes, so whole notes were also used for the flashcards. A sticker was placed on the back of each flashcard with the name of the note.

Students doing computer practice used the online music theory site, *Ricci Adams' Musictheory.net* (see Appendix D) (Adams, 2000). This site provides lessons and "trainers" in various musical concepts. The computer students used the *Note Trainer* drill for their practice time. The notes are presented one at a time, similar to a flashcard, and students click on the letter name of the note. The range of notes can be selected, and the computers were set to use only the lines and spaces of the treble staff.

Procedure

The study took place over a three-and-a-half week period in the middle of the first semester. Each class had three sessions, following its regular rotation schedule of coming every sixth school day (every eight to ten calendar days).

Session One. The session was divided into four sections: Pre-test, Lesson, Practice, and Post-test.

Pre-test. Clipboards with pencils and both pre-test and post-test were on the students' chairs as they entered the room. Students were asked to write their name at the top of the pre-test, then to replace their pencil on the clipboard and turn it over on their

lap. I explained that we were going to do a project on learning the notes of the staff, and we would begin by taking a pre-test like they do for spelling in their classrooms. Students were assured this was not for a grade, but only to find out what they already know. They could put a "?" in each blank where they did not know the notes. The timer was set for two minutes, pencils were picked up, and "go" was called. At the end of the two minutes students were instructed to put their pencils back on their clipboard. Leaving the clipboards on their chairs, students moved over to a rug by a whiteboard that had a large staff for the instruction time.

Lesson. The following lesson was presented to the students, introducing them to the notes of the treble staff (see Appendix E for a detailed lesson plan):

1. Present staff's five lines and four spaces (compare to hand's five fingers and the four spaces between fingers).
2. Draw a treble clef sign, naming the staff now as treble staff.
3. Place a star where the clef sign crosses the G line, and then out on the staff write G on the G line.
4. Explain musical alphabet (A comes after G).
5. Discover other names of notes on staff (stack line notes in a column, space notes in a column).
6. Draw a rectangle around the space notes, allowing students to discover the word *FACE*. Holding their "handy" staff (hand held sideways), point to each space naming the notes.
7. Ask if the notes of the lines make a word (no), but explain there are sentences to help us remember the order: Elvis' Guitar Broke Down Friday; Every Good Boy Deserves Fudge. Practice naming notes on students' "handy" staff.
8. Give guided practice on staff, using whole notes, half notes, quarter notes on different lines and spaces. Explain that it doesn't matter what kind of note is used (quarter, eighth, half), the name of the note is determined by what line or space the circle part of the note is on.

Practice. Before going to the computer lab, I explained that half of the class would be practicing notes with partners, and half of the class would be practicing their notes on the computer. The assignment of computer or partner was done before class by drawing names out of a box. Partner pairs were also determined beforehand by random

drawing (boys with boys, girls with girls).

Each method was demonstrated before going to the computer lab. Pairs would receive a pack of 27 flashcards (three sets of lines and spaces of treble staff) with answers on the back. One student would then show his or her partner one card at a time, correcting if the answer was incorrect. After completing the stack, the student would hand the card to their partner, and roles would be reversed. Partners would be allowed to talk as needed during the practice time. The *Note Trainer* computer site was then demonstrated to the students. Notes would appear one at a time, and the student would choose the correct letter name from a list at the bottom of the screen. A correct answer would advance the program to the next note while an incorrect answer would cause the correct letter name to appear in red next to the note for a few seconds before advancing to the next note. Computer students would not be allowed to talk to anyone during the practice time.

Following the demonstrations, the class lined up and went to the computer lab. Peer partners were assigned places spaced throughout the room, and had to wait with flashcards down until all the computer students had opened the website to the *Note Trainer* page. When all were ready, the timer was set for ten minutes and "go" was called. When the buzzer rang, students had to close out the computer program or put flashcards back in their stack. Computer stations were straightened up, and the students lined up to go back to the music room.

Post-test. Upon their return to the music room, students picked up their clipboards and put the post-test papers on top and wrote their names at the top. After their names were written, they had to return the pencils to the clipboards until all students were

ready to begin. Instructions were the same as for the pre-test: if students did not know the answer, they could place a question mark on the space. The time was set for two minutes, and "go" was called. When the buzzer rang, students placed their pencils on the clipboards and turned in the clipboards with papers and pencils still attached.

If there was time left in the class session, a song or game was played, but the notes were not discussed after the post-test.

Sessions Two and Three. For the next two sessions, the same procedure was followed. There was no review given before the two-minute pre-test. After the pre-test, students moved to the rug by the whiteboard for a review of the staff notes, followed by guided practice on the whiteboard staff. The class then moved to the computer lab, using the same procedure as for the first session. The same partners worked together each session; computer students used the same computer program as the first session. If a partner was absent, the remaining partner would switch to the computer for that session. If two partner sets were missing a student, those two remaining students were paired together for that session. Practice was timed for ten minutes, followed by another two-minute posttest back in the music classroom.

Results

Raw Data

All 114 third-grade students participated in the three-session project as part of our normal classroom activities. I purposely chose to wait until after the study was completed to begin to analyze the data so that I remained unbiased in my dealings with the two groups. After the last session, students' scores on each test were entered, by class and without student names, onto *Excel* spreadsheets (see Appendices F, G and H).

Disqualifications

Some students' scores were incomplete or were outside the parameters of the study. The breakdown as to how many students were disqualified as well as the reason is shown in Table 2 below.

Table 2
Reason for Disqualification by Class

	Absent session 1	Absent session 2	Absent session 3	Absent sessions 1 and 3	Absent sessions 2 and 3	Did not attempt answers	Previous knowledge of notes	Partner absent	Total disqualified
Class 1	1	1				2		1	5
Class 2	2		1		1		3		7
Class 3		1	2				2		5
Class 4		1	2						3
Class 5		2		2	1	1	1	1	**8**
Class 6		2	2		1	1			6
Totals	3	7	7	2	3	4	6	2	**34**

Twenty-four students were disqualified due to absences from one or more sessions. Six were disqualified for demonstrating prior knowledge of the names of the notes in the first pretest (five or more correct answers). There were four students disqualified because they did not even attempt any answers in the third session.

A total of 34 sets of scores were eliminated from the analysis of data. The computer-assisted group and the peer-partner group each ended up with 40 students. In the data analysis that follows, the number of participants (N) will equal 80. The computer-assisted students will be referred to as computer students, or the x group (N_x = 40) and the peer-partner students will be referred to as peer students, or the y group (N_y = 40). Table 3 below shows the distribution by class of those eliminated, and the breakdown of computer and peer students in each class.

Table 3
Number Disqualified by Class

	Total in class	Disqualified	Total in study	Computer Total	Peer Total
Class 1	17	5	12	6	6
Class 2	20	7	13	7	6
Class 3	15	5	10	4	6
Class 4	21	3	18	10	8
Class 5	20	8	12	7	5
Class 6	21	6	15	6	9
Totals	**114**	**34**	**80**	**40**	**40**

Mean Scores

Test scores. The first set of data compiled was the mean scores of each pre-test and post-test for computer and peer students. Table 4 compares the mean scores of the two groups of students.

Table 4
Mean Scores of Pre-tests and Post-tests (number answered correctly)

Mean Scores	Pre-test 1	Post-test 1	Pre-test 2	Post-test 2	Pre-test 3	Post-test 3
Computer	0.55	19.70	18.50	26.40	26.95	27.18
Peer	0.75	9.40	8.45	17.45	15.30	20.85

After the first pre-test, where both groups had an average of less than one question answered correctly, computer students were consistently ahead of the peer students. The graph in *Figure 1* that follows shows the difference in the scores.

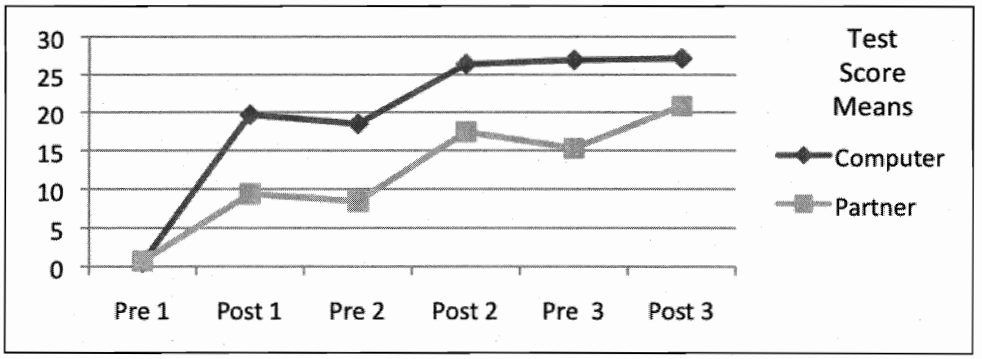


Figure 1. Test score means of third grade students.

T tests were run on each pre-test and post-test to check for significant differences between the two groups. Those results are listed below in Table 5. The *t* test on the first pre-test was done to prove the null hypothesis between the two groups to be studied, to make sure the groups were similar in make-up. Indeed, no difference between the two groups was found at the beginning of the study. In the remainder of the tests, the null hypothesis was rejected in each case, showing the difference to be due to the treatment.

Table 5
T *tests on Test Score Means*

	Pre-test 1	Post-test 1	Pre-test 2	Post-test 2	Pre-test 3	Post-test 3
two-tailed P	0.406	<0.0001	0.0003	0.0026	0.0001	0.0159
statistical significance	**not significant**	**extremely significant**	**extremely significant**	**very significant**	**extremely significant**	**significant**
M_x-M_y	-0.20	10.30	10.05	8.95	11.65	6.32
95% confidence interval of this difference	from -0.68 to 0.28	from 6.02 to 14.58	from 4.74 to 15.36	from 3.23 to 14.67	from 5.91 to 17.39	from 1.22 to 11.43
SD_x	0.9	10.1	12.18	12.28	12.7	11.42
SEM_x	0.14	1.60	1.93	1.94	2.01	1.81
N_x	40	40	40	40	40	40
SD_y	1.21	9.09	11.67	13.41	13.09	11.53
SEM_y	0.19	1.44	1.85	2.12	2.07	1.82
N_y	40	40	40	40	40	40
T	0.8355	4.7951	3.767	3.1124	4.0397	2.465
Df	78	78	78	78	78	78
standard error of difference	0.239	2.148	2.668	2.876	2.884	2.566

Note. *T* tests were calculated at www.graphpad.com/quickcalcs/ttest1.cfm (GraphPad Software, Inc., 2002).

To further compare the groups, a two-factor Analysis of Variance (ANOVA) with repeated measures was run on the two groups. Table 6 below summarizes the data from the ANOVA.

Table 6
Two-Factor ANOVA with Repeated Measures on One Factor

ANOVA Summary: 2rows x 3columns A = groups: the between-subjects variable delineated by the rows B = the repeated-measures variable delineated by the columns					
Source	**SS**	**df**	**MS**	**F**	**P**
Between Subjects	28843.33	79			
A	4360.54	1	4360.54	13.89	0.000365
Subjects within A	24482.79	78	313.88		
Within Subjects	10003.33	160			
B	3954.32	2	1977.16	52.4	<.0001
A x B	163.43	2	81.71	2.17	0.117612
B x Subjects within A	5885.58	156	37.73		
TOTAL	38846.66	239			

Note. ANOVA test was calculated at http://faculty.vassar.edu/lowry/anova2corr.html (Lowry, 2001).

The ANOVA analysis between subjects (A) confirms that the difference between the two groups is due to the treatment (computer vs. peer) and not due to chance. Likewise, the *P* factor within the repeated measures (B) shows students were able to improve their performance throughout the study. The *P* factor of the comparison of the two factors (A x B) indicates there is not a relationship between the two factors, that the progress made over repeated sessions was not due to the student's group assignment.

Gain/loss. Table 7 shows the means of the gain or loss in number of correct answers between tests (see Appendices I and J for raw data). There are two important reasons to look at this data. First of all, this study's goal is to compare the efficiency of computer and peer practice, and the gain/loss between the pre-test and post-test of each session is the most accurate indicator of that efficiency. Secondly, due to the great span

of days between classes (eight to ten days), looking at the scores between the post-test of one session to the next session's pre-test can give insight to the amount of retention or loss of the information learned during the previous session.

Table 7
Mean Gain/Loss in Scores between Tests

Mean gain/loss in scores	Pre-1 to Post-1	Post-1 to Pre-2	Pre-2 to Post-2	Post-2 to Pre-3	Pre-3 to Post-3	Pre-1 to Post-3
Computer	19.15	-1.20	7.90	0.55	0.23	26.63
Peer	8.65	-0.95	9.00	-2.15	5.55	20.10

Gain/loss from pre-tests to post-tests. These figures show the gain/loss during the class session. The computer group's gain was more than twice that of the peer group during the first session (Pre-test 1 to Post-test 1), but in the second session (Pre-test 2 to Post-test 2), the peer group experienced a slightly higher gain in score than the computer group. In the third session, the computer group had very little gain, while the peer group still improved their score by over five and a half points.

Gain/loss from post-tests to pre-tests. These scores reflect the degree of retention between sessions. Both groups showed losses in their scores from the first session to the second session, but only by about a point. The computer group experienced a very slight gain between sessions two and three, while the peer group lost over twice as much as they had between the first and second sessions.

Total gain/loss. The last column in Table 6 gives the mean of the total gain in the study by group. From the Pre-test 1 to the Post-test 2, the computer group gained an average of 26.63 correct answers, while the peer group's average gain was 20.10. The computer group's gain is 32.5% more than the peer group over the course of the study.

The graph in *Figure 2* visualizes the gain/loss of test score means of both computer and peer groups.

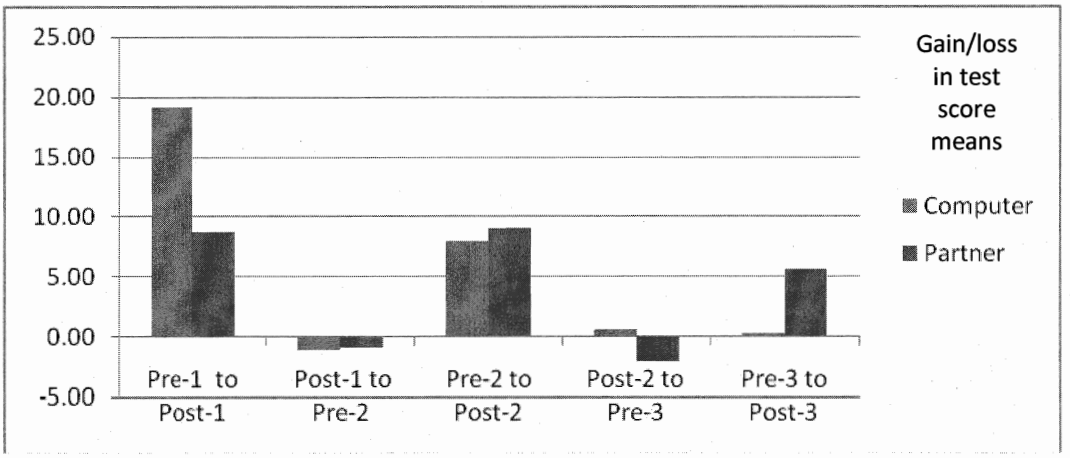


Figure 2. Gain/loss in test score means between tests.

The drop in gains for the computer group during subsequent sessions (Pre-tests to Post-tests) is dramatic. The peer group actually increased their gain in the second session, and then dropped off somewhat during the third session. It is interesting to note that the computer group improved their retention between Post-test 2 and Pre-test 3 while the peer group retained even less between the second and third sessions.

Discussion

The results show the students who participated in the computer-assisted practice scored higher throughout the study than the students who participated in the peer-partner practice. Table 8 shows difference in percentage of the computer scores over the peer scores.

Table 8.
Difference in Computer and Peer Mean Scores in Percentage

Comparing computer to peer mean scores	Pre-test 1	Post-test 1	Pre-test 2	Post-test 2	Pre-test 3	Post-test 3
% higher	-26.7%	109.6%	118.9%	51.3%	76.1%	30.4%

At the end of the first session, the computer students scored 109.6% higher than the peer students. That difference dropped to 51.3% after the second session as the peer students improved slightly more than the computer students. In the third session, the peer students had higher gains from the second session than the computer group, but the computer scores still averaged 30.4% higher.

While I started with the hypothesis that computer practice would yield better scores than peer practice, I began to doubt that hypothesis during the first session. There was a lot of re-teaching happening between the peer partners ("Remember, the spaces spell *FACE,*" or "The top line is *F,* as in Friday.") which I saw as positive to learning. The only feedback the computer students received on a wrong answer was a red letter next to the note giving the correct answer for approximately two seconds before going on to the next note. I thought at that point the peer students had the advantage. However, I began to see another pattern that I believe had a greater impact on the results.

During the practice time I moved around the room monitoring and could see on the computer screens the running total of how many notes the computer students had answered. Computer students were naming anywhere from 60–100 notes in that first session. While lining up to go back to the music room after the practice, I asked the peer partners how many times they had gotten through the stack of 27 flashcards. The typical answer was one or one and a half times through the set, which meant the peer groups had only looked at between 27–40 different cards (about half the number of notes the computer students had seen). At the second session practice, the peer partners got through the flashcard set two to three times (54–81 notes), but during that same time most of the computer students were well past 100 notes, and some were approaching 200 notes

practiced. That trend continued into the third session, where many computer students reached 200 notes answered while the peer students were getting through the flashcards three to five times (81–135). Unfortunately, these figures are estimates based on my own observations, and not exact data. I regret not having had students record the number of notes they practiced each session, because I now believe the higher number of notes practiced had a positive impact on the computer students' higher scores. In the third session where the peer students' scores were similar to the computer group's first session, the number of notes practiced by the peer groups was also similar to the computer group's first session. Therefore, while the two groups had the same amount of practice in number of minutes, they did not see the same number of notes to practice. It would be interesting to replicate this study, but with the added data of the number of notes each student practiced in each session to further study the correlation of scores to number of notes practiced

The motivation for this study was to find the most efficient method of practice, so it is important to note that on average it took the peer students *three* sessions to approach the scores the computer students reached in the *first* session. While the re-teaching the students did was not bad in itself, it did use up time, as did the physical manipulation of the flashcards. The computers allowed the students to focus exclusively on the specific skill to be practiced without extra talking or distraction. The result seems to be more efficient practice and higher mastery of the skill. The computer's lack of spoken language especially benefited the computer students in the bilingual class. The scores of those students were comparable to computer students in the other classes while the scores

of the peer students in the bilingual class were lower than any other class throughout the study (see Appendix J).

There was another interesting phenomenon found in the data. While all classes' mean scores improved between the first and second sessions, computer mean scores in three classes and peer mean scores in two classes actually declined after the third session (see Appendix J). Most of those mean scores were only about a point less than the second session, with one class group dropping five-and-a-half points in their mean score. The computer group that had the most drastic drop had the highest mean score of the entire study in the second session. My conjecture as to the decline is that students were beginning to have test fatigue. In the first session everything was new and students were excited about the project. The second session found the students not as excited, but still with a positive attitude, being familiar with the routine. In the third session, some students said, "We're doing THAT again?" I assured them that was the last session, and encouraged everyone to do their best. However, those that obviously knew their notes tended to be more bored in the third session. Three sessions were not really necessary, especially for the computer students.

There is a need for continued study in how to use computers for the most efficient learning. For example, there is a feature on the *Note Trainer* called "Toggle Helpers." When activated, the names of the lines and spaces appear at the end of the staff. (For this present study, I did not allow students to use this feature to keep the computer drill as similar to flashcards as possible.) It would be interesting to compare the use of the "Toggle Helpers" for all or part of the drill session to see if it has an effect on the mastery of note recognition. There are also other online sites where students can practice notes in

a variety of styles ranging from flashcard drill to video game format. Comparing these different delivery styles to determine their effectiveness would be another project worthy of study.

Conclusion

Computers have become an integral part of our daily lives, and we would be remiss if we did not utilize them in our music classrooms as a tool for learning. This study showed that computer-assisted practice is more effective than peer-partner practice with flashcards in learning the pitch notation of the treble staff. Using computer drill achieved levels that peer practice took three times as long to reach. As a result of this research project, I will definitely use computer drill with my students. This will allow more time to apply the students' note knowledge to the actual reading and writing of music (Standard 5) and singing and playing music (Standards 1 and 2) (Consortium of National Arts Education Associations, 1994).

References

Adams, R. (2000). *Note Trainer*. Retrieved October-November 2009, from Ricci Adams' Musictheory.net: http://musictheory.net/trainers/html/id82_en.html

Alexander, L., & Dorow, L. G. (1983). Peer tutoring effects on the music performance of tutors and tutees in beginning band classes. *Journal of Research in Music Education, 31*(1), 33-47.

Beckstead, D. (2001). Will technology transform music education? *Music Educators Journal, 87*(6), 44-49.

Boling, C., Martin, S. H., & Martin, M. A. (2002). The effects of computer-assisted instruction on first grade students' vocabulary development. *Reading Improvement, 39*(2), 79-88.

Carlyle, M. (2006). *Reading instruction software vs. peer tutoring for improving oral reading fluency*. Masters' Thesis, Charleston, Illinois: Eastern Illinois University.

Cates, G. L. (2005). Effects of peer versus computer-assisted drill on mathematics response rates. *Psychology in the Schools, 42*(6), 637-646.

Consortium of National Arts Education Associations. (1994). *National Standards for Arts Education: What Every Young American Should Know and Be Able to Do in the Arts.* Reston, VA: Music Educators National Conference.

Consortium of National Arts Education Associations. (1995). *Opportunity-to-Learn Standards for Arts Education.* Reston, VA: Music Educators National Conference.

Darrow, A.-A., Gibbs, P., & Wedel, S. (2005). Use of *ClassWide Peer Tutoring* in the general music classroom. *Update: Applications of Research in Music Education, 24*, 15-26.

Fuchs, D., Fuchs, L. S., Mathes, P. G., & Simmons, D. C. (1997). Peer-assisted learning strategies: Making classrooms more responsive to diversity. *American Educational Research Journal, 34*(1), 174-206.

Fuson, K. C., & Brinko, K. T. (1985). The comparative effectiveness of microcomputers and flash cards in the drill and practice of basic mathematics facts. *Journal for Research in Mathematics Education, 16*(3), 225-232.

GraphPad Software, Inc. (2002). *GraphPad QuickCalcs: t test calculator*. Retrieved March 12, 2010, from GraphPad Software: http://www.graphpad.com/quickcalcs/ttest1.cfm

Greenwood, C. R., Delquadri, J. C., & Hall, R. V. (1989). Longitudinal effects of *ClassWide Peer Tutoring. Journal of Educational Psychology, 81*(3), 371-383.

Hoffman, J. (1991). Computer-aided collaborative music instruction. *Harvard Educational Review,* 270-278.

King-Sears, M. E., & Bradley, D. F. (1995). *ClassWide Peer Tutoring. Preventing School Failures, 40*(1), 29-35.

Lowry, R. (2001). Two-Factor ANOVA with Repeated Measure on One Factor. Retrieved March 28, 2010, from Two-Way ANOVA: http://faculty.vassar.edu/lowry/anova2corr.html

Nicholson, T. (1998). The flashcard strikes back. *The Reading Teacher, 52*(2), 188-192.

Palombella, A. L., & Johnson, D. P. (2005). The design, use and evaluation of hypermedia flashcards as a teaching tool. *TechTrends: Linking Research & Practice to Improve Learning*, 46-54.

Peters, G. D. (1992). Music software and emerging technology. *Music Educators Journal, 7* (3), 22-25+63.

Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how and what children learn in school with computer-based technologies. *The Future of Technology , 10*(2), 76-101.

Tan, A., & Nicholson, T. (1997). Flashcards revisited: Training poor readers to read words faster improves their comprehension of text. *Journal of Educational Psychology, 89*(2), 276-288.

Texas Music Administrators Conference. (2005). *The Texas School Music Program.* Retrieved March 18, 2010, from Texas Music Educators Association: http://www.tmea.org/027_Magazine/Special_Edition/texas_music_program_r.htm #Elementary Level

Willett, B. E., & Netusil, A. J. (1989). Music computer drill and learning styles at the fourth-grade level. *Journal of Research in Music Education, 37*(2), 219-229.

Appendix A

National Standards for Music Education

1. Singing, alone and with others, a varied repertoire of music.
2. Performing on instruments, alone and with others, a varied repertoire of music.
3. Improvising melodies, variations, and accompaniments.
4. Composing and arranging music within specified guidelines.
5. Reading and notating music.
6. Listening to, analyzing, and describing music.
7. Evaluating music and music performances.
8. Understanding relationships between music, the other arts, and disciplines outside the arts.
9. Understanding music in relation to history and culture. (Consortium of National Arts Education Associations, 1994)

Appendix B

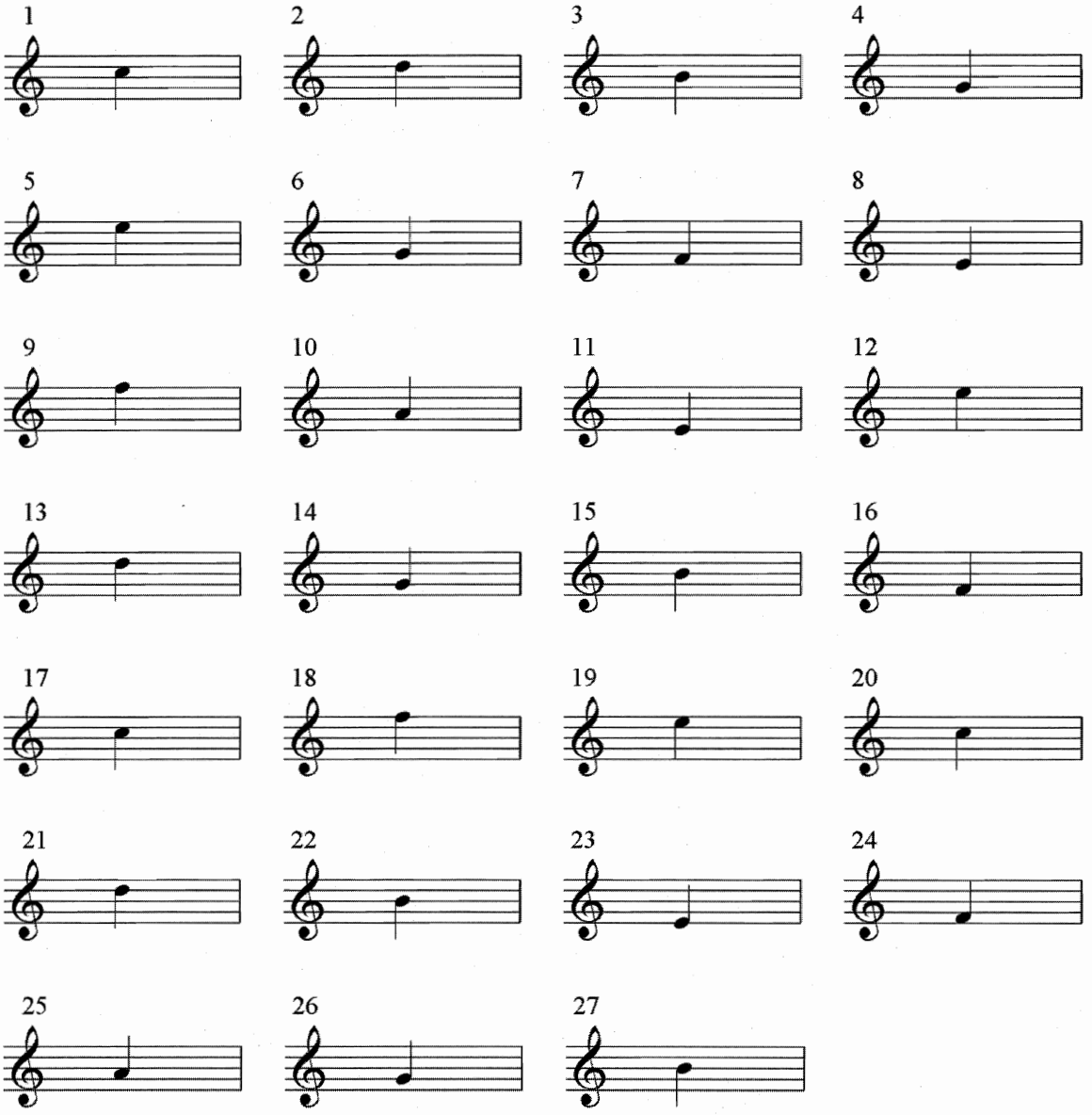
Pre-test and Post-test Sample Format

Name _____

Class _____

Match Pitches & Names, Treble Staff--Pre-1

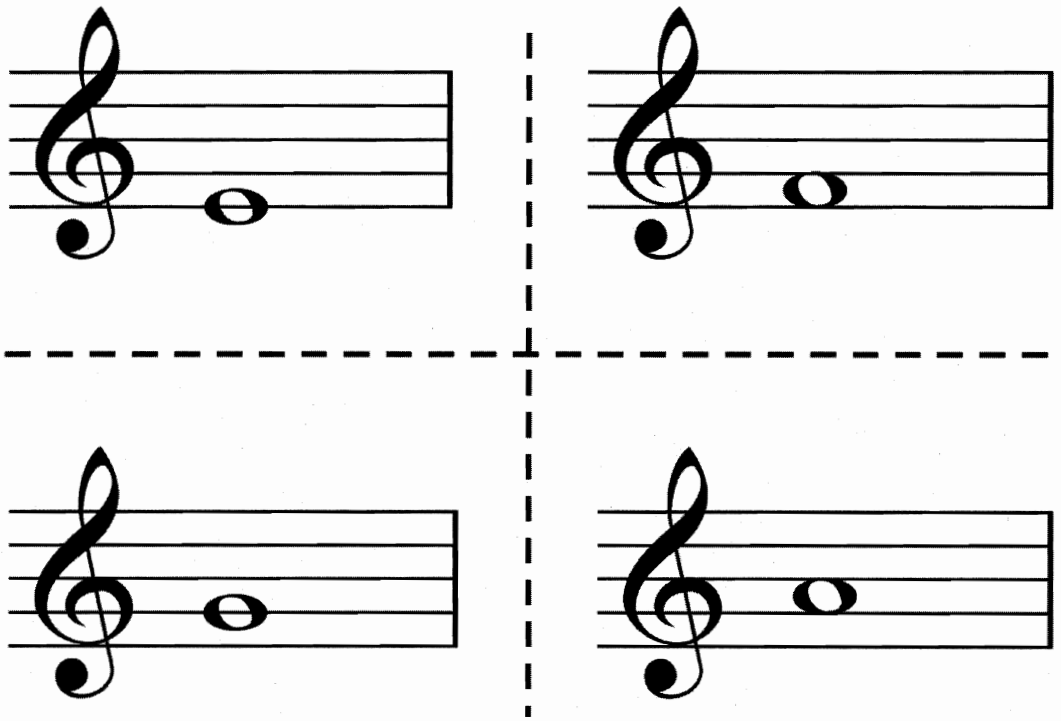
Match each pitch with its name | A | B | C | D | E | F | G |



Tests were created with *Sibelius 5.* Blanks under the notes were added before copying.

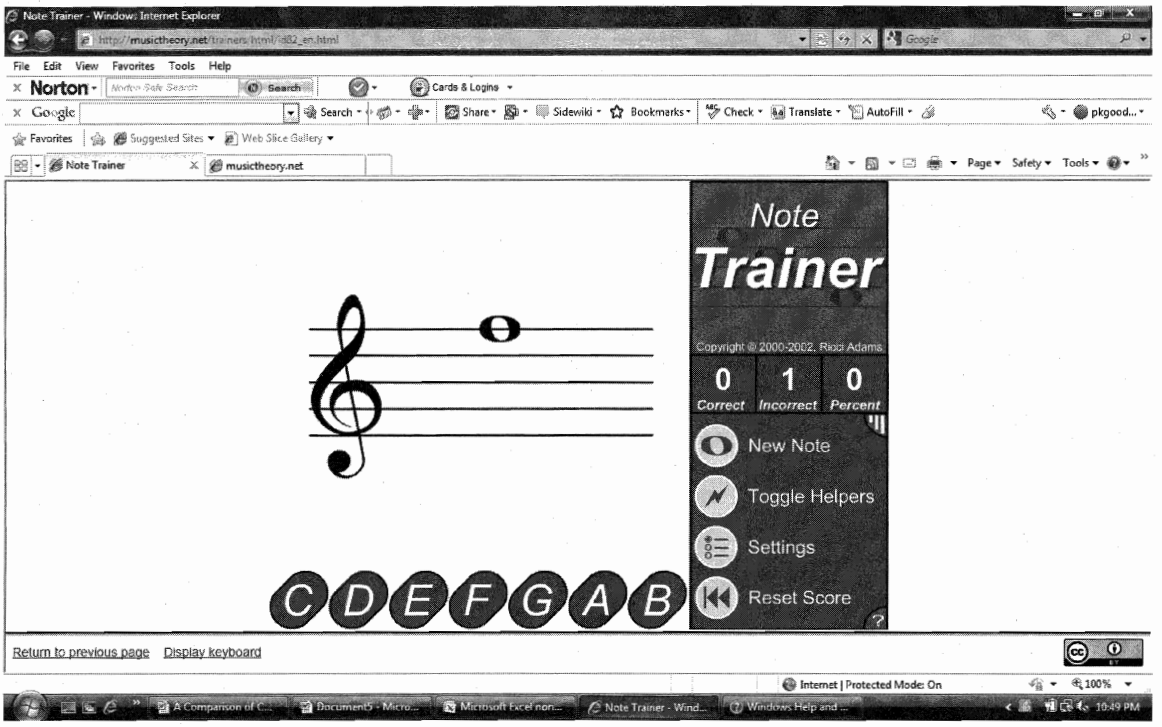
Appendix C

Flashcard Sample



Appendix D

Computer Monitor View of *Note Trainer*



musictheory.net/trainers/html/id82_en.html (Adams, 2000)

Appendix E

Lesson Plan for Presenting Treble-Staff Notes Names

Objective: By the end of the lesson, the student will be able to identify the staff, the treble clef sign, and the names of the notes of the lines and spaces of the treble staff.

1. Draw a staff on the board, asking the class to derive the number of lines and spaces of the staff. Show how students can create their own "handy" staff with their own hand, looking at their palm (thumb pointing up). Explain that these lines do not have names, because we don't know what kind of staff it is.
2. Draw the treble clef sign at the beginning of the staff. "This is a treble clef sign, and when we put it at the beginning of the staff, the staff becomes a TREBLE STAFF. Now each line and space has a name.
3. Can you see the letter *G* in the middle of the treble clef sign?" Outline the middle of the treble clef sign that curves like the letter *G*. "This sign is also called the 'G clef,' and the second line where the clef sign ends is named *G*." Write the letter *G* out on the second line on the staff.
4. Explain that in music we only use the first seven letters of the alphabet. Write them on the board below the staff, and then sing the "Musical Alphabet Song" to the tune of *Twinkle, Twinkle, Little Star*: *ABCDEFG, ABCDEFG, ABCDEFG, ABCDEFG, ABCDEFG, ABCDEFG.* "What letter always came after *G*?" (*A*)
5. "When we go up the staff, we count every line and space, each one getting a letter going forwards in the alphabet with *A* always following *G*." Write the names on the lines and spaces from the second line *G* up to the top line, creating separate columns for the line notes and the space notes. "To go down the staff, we count

every line and space, but go *backwards* in the musical alphabet. Let's sing the Musical Alphabet Song backwards: *GFEDCBA, GFEDCBA, etc."* Starting on the *G* line, fill in the *F* and *E* notes as students derive names of the remaining line and space.

6. Draw a rectangle around the column of space notes, and ask, "Does anyone see a word here?" When a student identifies the word as *FACE*, have students hold up their hand and point to the four spaces from the bottom up spelling *FACE.* "Remember, all the *space* notes spell *FACE.*"
7. Draw a rectangle around the column of line notes, and ask, "Does anyone see a word here?" After student attempts to find a word, explain there is no such word as *EGBDF,* but we can use those letters as the beginning of the words of a phrase such as *Elvis' Guitar Broke Down Friday.* Invite students to repeat the phrase while point to each corresponding line. Repeat the phrase again using their "handy" staff, and then point to each finger saying only the first letter of each word.
8. Give guided practice identifying notes on the staff using various types of notes (whole, half, quarter, etc.) to demonstrate that the length of the note does not affect the pitch name of the note.

Appendix F

Raw Scores for Computer-Assisted Practice Students

Student Study #	M/F	Pre-1 att.	Pre-1 cor.	Post-1 att.	Post-1 cor.	Pre-2 att.	Pre-2 cor.	Post-2 att.	Post-2 cor.	Pre-3 att.	Pre-3 cor.	Post-3 att.	Post-3 cor.
30101	M	0	0	15	13	19	15	23	23	24	24	25	24
30105	M	4	0	23	23	25	25	27	27	33	32	31	31
30110	F	29	2	34	34	38	37	32	32	42	42	37	37
30111	F	8	1	27	27	17	17	26	26	30	30	32	32
30113	M	3	1	7	7	8	6	20	20	20	20	26	26
30115	F	1	0	9	4	0	0	16	4	19	0	17	0
30203	M	0	0	22	22	16	13	23	23	27	27	27	27
30206	F	11	2	26	26	26	26	29	29	27	27	32	32
30210	F	4	0	18	17	26	26	34	27	27	27	22	22
30214	M	0	0	6	6	7	3	16	16	11	11	4	4
30218	F	0	0	27	27	31	31	27	27	31	31	29	29
30219	F	7	3	25	25	27	25	27	27	30	30	32	31
30220	M	4	0	20	20	27	27	27	27	32	32	27	27
30304	F	14	0	16	10	15	12	34	34	29	29	30	30
30312	F	0	0	27	27	37	37	37	37	49	47	49	49
30314	F	0	0	5	3	0	0	0	0	12	8	17	10
30315	F	0	0	14	14	16	16	17	17	14	14	24	24
30402	F	17	0	18	18	20	20	23	23	27	27	31	31
30405	F	0	0	21	21	11	10	40	40	31	31	36	36
30406	F	2	0	20	20	20	20	18	18	6	6	20	20
30408	F	0	0	16	16	14	14	33	33	27	27	27	27
30411	M	7	1	23	23	24	23	31	30	31	30	31	31
30412	F	0	0	22	22	17	17	32	32	30	30	27	26
30413	F	0	0	11	11	7	4	27	27	27	27	28	28
30414	F	19	1	13	1	5	3	27	26	27	25	36	35
30418	F	10	2	27	27	27	27	50	50	37	37	39	39
30421	M	0	0	5	4	0	0	4	4	3	3	8	8
30501	F	0	0	20	11	25	4	22	16	22	19	32	31
30503	M	5	1	19	19	14	14	19	19	27	27	20	20
30504	F	13	0	22	22	19	19	18	18	27	27	25	25
30512	M	0	0	13	13	3	3	18	18	17	17	9	9
30518	F	0	0	32	32	49	49	42	42	54	54	53	53
30519	F	18	2	27	27	31	30	31	31	35	35	31	31
30520	F	8	0	24	21	25	24	27	26	33	32	29	28
30601	M	17	1	41	40	37	37	44	44	28	28	28	28
30602	F	16	3	31	31	30	30	42	42	47	47	44	44
30607	F	0	0	32	6	12	3	46	4	50	5	47	4
30608	F	11	2	35	35	31	31	45	45	47	47	39	39
30610	F	3	0	23	23	15	15	18	18	17	17	26	26
30619	F	0	0	40	40	27	27	54	54	49	49	33	33

att. = attempted cor. =correct

Appendix G

Raw Scores for Peer-Partner Practice Students

Student Study #	M/F	Pre-1 att.	Pre-1 cor.	Post-1 att.	Post-1 cor.	Pre-2 att.	Pre-2 cor.	Post-2 att.	Post-2 cor.	Pre-3 att.	Pre-3 cor.	Post-3 att.	Post-3 cor.
30102	F	3	0	12	4	5	0	22	19	19	17	20	20
30103	F	0	0	12	6	9	2	22	2	27	0	25	1
30106	F	0	0	19	12	12	9	28	28	12	7	25	24
30107	M	0	0	33	4	19	4	3	0	21	3	27	5
30112	M	0	0	12	0	4	1	14	2	6	0	10	0
30114	F	19	2	25	1	11	0	42	8	13	3	23	4
30201	M	0	0	14	3	18	1	23	23	16	2	22	22
30202	M	0	0	10	4	10	1	23	23	23	23	27	27
30207	M	3	0	23	23	27	27	38	38	30	30	41	41
30208	F	5	0	12	12	9	2	9	6	12	8	23	23
30209	M	0	0	0	0	0	0	10	10	14	13	19	19
30213	F	0	0	13	1	16	4	14	5	14	2	25	25
30301	M	19	4	15	15	12	12	27	27	15	15	27	27
30302	F	5	0	27	7	6	0	5	5	4	2	13	11
30305	F	0	0	8	5	0	0	4	1	1	1	22	15
30306	F	20	2	23	23	27	27	34	34	31	31	34	34
30308	M	7	0	24	24	35	35	30	30	27	27	27	26
30310	F	4	2	27	27	44	44	43	43	49	48	54	54
30401	F	0	0	7	4	1	0	16	14	10	2	17	17
30403	M	9	1	27	27	17	17	38	38	27	27	23	23
30404	M	2	0	25	24	24	24	27	27	30	30	23	23
30407	M	28	1	15	3	27	4	11	0	15	5	20	17
30409	M	13	1	7	1	11	0	27	27	20	20	27	27
30415	F	13	2	26	3	8	0	20	20	23	21	22	21
30417	F	8	2	12	11	18	18	30	25	19	19	16	16
30419	F	7	0	18	18	29	29	34	34	27	27	31	31
30502	F	0	0	20	20	27	27	33	33	31	31	27	27
30505	F	2	0	25	17	23	12	25	25	23	23	31	26
30506	F	0	0	0	0	0	0	0	0	0	0	26	26
30507	F	0	0	15	14	11	6	29	29	32	32	27	27
30513	M	8	1	17	8	11	8	28	26	28	15	27	27
30603	F	0	0	2	0	5	4	19	19	15	11	27	27
30612	F	11	0	27	1	14	0	27	27	42	42	35	35
30613	M	12	0	13	0	14	0	35	0	17	3	12	2
30614	M	8	4	45	8	24	5	30	6	52	4	52	2
30615	M	9	2	24	24	5	0	27	27	27	27	24	24
30617	M	10	2	18	3	1	0	12	0	17	8	21	21
30618	F	0	0	0	0	0	0	0	0	54	6	54	6
30620	F	18	4	18	18	15	15	17	17	27	27	27	27
30621	M	0	0	1	1	0	0	0	0	0	0	8	4

att. = attempted cor. = correct

Appendix H

Raw Scores of Disqualified Students and Reason for Disqualification

Student Study #	Comp. or Peer	M/F	Pre-1 att.	Pre-1 cor.	Post-1 att.	Post-1 cor.	Pre-2 att.	Pre-2 cor.	Post-2 att.	Post-2 cor.	Pre-3 att.	Pre-3 cor.	Post-3 att.	Post-3 cor.
31108	C1	F					0	0	1	0	0	0	7	0
31211	C2	M					6	2	23	23	13	13	29	29
31221	C2	F					0	0	6	2	27	4	25	4
32117	P13	F	0	0	6	2					6	4	37	9
32311	C3	M	11	0	22	22					34	34	27	27
32416	C4	M	0	0	14	14					8	0	32	32
32515	C5	F	0	0	20	20					16	0	40	40
32516	P51	M	0	0	20	20					14	14	24	23
32606	C6	M	2	0	17	17					5	5	24	24
32611	C6	F	0	0	14	1					21	1	46	4
33215	P24	F	2	0	18	18	5	5	27	27				
33309	P33	F	2	2	24	23	23	20	21	21				
33313	C3	F	0	0	31	31	22	22	42	42				
33410	P43	F	0	0	10	10	4	4	16	16				
33420	P44	F	0	0	18	18	20	20	36	36				
33604	C6	F	0	0	6	2	0	0	17	3				
33609	C6	M	0	0	27	27	22	22	28	28			27	27
34508	C5	M					0	0	0	0				
34510	C5	F					0	0	11	3				
35212	C2	F	14	0	10	9								
35517	P55	F	2	0	19	19								
35605	C6	M	0	0	4	0								
36109	P11	M	8	3	4	0	8	0	9	3	14	3	0	0
36116	P12	M	0	0	1	0	0	0	0	0	0	0	0	0
36514	P53	F	0	0	0	0	0	0	0	0	0	0	0	0
36616	P62	M	0	0	5	3	0	0	0	0	0	0	0	0
37205	P23	F	20	6	24	24	26	26	27	27	37	37	43	43
37216	P23	F	9	9	27	27	31	31	51	51	40	40	39	39
37217	P24	F	9	5	24	24	27	27	32	32	36	36	34	34
37303	P32	F	29	29	31	31	45	45	44	44	40	40	38	38
37307	C3	F	27	27	37	36	39	39	39	39	39	38	49	49
37509	P53	F	28	28	27	27	32	32	29	29	35	35	30	30
38104	P13	F	0	0	8	3	9	4	17	17	21	20	26	26
39511	P55	F	0	0	16	16	27	27	34	34	42	42	35	35

Code for Student Study #:
x**X**xxx (thousands' digit)

1=student missed first session
2=student missed second session
3=student missed third session
4=student missed first and third sessions
5=student missed second and third sessions
6=student did not attempt any answers in third session
7=student already knew notes
8=partner absent second session, switched to computer
9=partner absent third session, switched to computer

Appendix I

Gain/Loss between Tests of Computer-Assisted Practice Students

Student Study #	Computer or Peer	M/F	gain/loss Pre-1 to Post 1	gain/loss Post-1 to Pre-2	gain/loss Pre-2 to Post 2	gain/ loss Post-2 to Pre-3	gain/loss Pre-3 to Post-3	gain/loss Pre 1 to post 3
30101	C1	M	13	2	8.00	1	0.00	24.00
30105	C1	M	23	2	2.00	5	-1.00	31.00
30110	C1	F	32	3	-5.00	10	-5.00	35.00
30111	C1	F	26	-10	9.00	4	2.00	31.00
30113	C1	M	6	-1	14.00	0	6.00	25.00
30115	C1	F	4	-4	4.00	-4	0.00	0.00
30203	C2	M	22	-9	10.00	4	0.00	27.00
30206	C2	F	24	0	3.00	-2	5.00	30.00
30210	C2	F	17	9	1.00	0	-5.00	22.00
30214	C2	M	6	-3	13.00	-5	-7.00	4.00
30218	C2	F	27	4	-4.00	4	-2.00	29.00
30219	C2	F	22	0	2.00	3	1.00	28.00
30220	C2	M	20	7	0.00	5	-5.00	27.00
30304	C3	F	10	2	22.00	-5	1.00	30.00
30312	C3	F	27	10	0.00	10	2.00	49.00
30314	C3	F	3	-3	0.00	8	2.00	10.00
30315	C3	F	14	2	1.00	-3	10.00	24.00
30402	C4	F	18	2	3.00	4	4.00	31.00
30405	C4	F	21	-11	30.00	-9	5.00	36.00
30406	C4	F	20	0	-2.00	-12	14.00	20.00
30408	C4	F	16	-2	19.00	-6	0.00	27.00
30411	C4	M	22	0	7.00	0	1.00	30.00
30412	C4	F	22	-5	15.00	-2	-4.00	26.00
30413	C4	F	11	-7	23.00	0	1.00	28.00
30414	C4	F	0	2	23.00	-1	10.00	34.00
30418	C4	F	25	0	23.00	-13	2.00	37.00
30421	C4	M	4	-4	4.00	-1	5.00	8.00
30501	C5	F	11	-7	12.00	3	12.00	31.00
30503	C5	M	18	-5	5.00	8	-7.00	19.00
30504	C5	F	22	-3	-1.00	9	-2.00	25.00
30512	C5	M	13	-10	15.00	-1	-8.00	9.00
30518	C5	F	32	17	-7.00	12	-1.00	53.00
30519	C5	F	25	3	1.00	4	-4.00	29.00
30520	C5	F	21	3	2.00	6	-4.00	28.00
30601	C6	M	39	-3	7.00	-16	0.00	27.00
30602	C6	F	28	-1	12.00	5	-3.00	41.00
30607	C6	F	6	-3	1.00	1	-1.00	4.00
30608	C6	F	33	-4	14.00	2	-8.00	37.00
30610	C6	F	23	-8	3.00	-1	9.00	26.00
30619	C6	F	40	-13	27.00	-5	-16.00	33.00
Means:			19.15	-1.2	7.90	0.55	0.23	26.63

Appendix J

Gain/Loss between Tests of Peer-Partner Practice Students

Student Study #	Computer or Partner	M/F	gain/loss Pre-1 to Post-1	gain-loss Post-1 to Pre-2	gain/loss Pre-2 to Post 2	gain/loss Post-2 to Pre-3	gain/loss Pre-3 to Post 3	gain from pre-1 to post-3
30102	P14	F	4.00	-4	19.00	-2	3.00	20
30103	P15	F	6.00	-4	0.00	-2	1.00	1
30106	P14	F	12.00	-3	19.00	-21	17.00	24
30107	P11	M	4.00	0	-4.00	3	2.00	5
30112	P12	M	0.00	1	1.00	-2	0.00	0
30114	P15	F	-1.00	-1	8.00	-5	1.00	2
30201	P22	M	3.00	-2	22.00	-21	20.00	22
30202	P21	M	4.00	-3	22.00	0	4.00	27
30207	P22	M	23.00	4	11.00	-8	11.00	41
30208	P25	F	12.00	-10	4.00	2	15.00	23
30209	P21	M	0.00	0	10.00	3	6.00	19
30213	P25	F	1.00	3	1.00	-3	23.00	25
30301	P31	M	11.00	-3	15.00	-12	12.00	23
30302	P32	F	7.00	-7	5.00	-3	9.00	11
30305	P34	F	5.00	-5	1.00	0	14.00	15
30306	P34	F	21.00	4	7.00	-3	3.00	32
30308	P31	M	24.00	11	-5.00	-3	-1.00	26
30310	P33	F	25.00	17	-1.00	5	6.00	52
30401	P43	F	4.00	-4	14.00	-12	15.00	17
30403	P41	M	26.00	-10	21.00	-11	-4.00	22
30404	P41	M	24.00	0	3.00	3	-7.00	23
30407	P42	M	2.00	1	-4.00	5	12.00	16
30409	P42	M	0.00	-1	27.00	-7	7.00	26
30415	P45	F	1.00	-3	20.00	1	0.00	19
30417	P45	F	9.00	7	7.00	-6	-3.00	14
30419	P44	F	18.00	11	5.00	-7	4.00	31
30502	P54	F	20.00	7	6.00	-2	-4.00	27
30505	P52	F	17.00	-5	13.00	-2	3.00	26
30506	P52	F	0.00	0	0.00	0	26.00	26
30507	P54	F	14.00	-8	23.00	3	-5.00	27
30513	P51	M	7.00	0	18.00	-11	12.00	26
30603	P64	F	0.00	4	15.00	-8	16.00	27
30612	P64	F	1.00	-1	27.00	15	-7.00	35
30613	P63	M	0.00	0	0.00	3	-1.00	2
30614	P62	M	4.00	-3	1.00	-2	-2.00	-2
30615	P63	M	22.00	-24	27.00	0	-3.00	22
30617	P61	M	1.00	-3	0.00	8	13.00	19
30618	P65	F	0.00	0	0.00	6	0.00	6
30620	P65	F	14.00	-3	2.00	10	0.00	23
30621	P61	M	1.00	-1	0.00	0	4.00	4
Means:			8.65	-0.95	9.00	-2.15	5.55	20.10

Appendix K

Mean Scores by Class

Post-test 1 Mean Scores	Class 1*	Class 2	Class 3	Class 4	Class 5	Class 6
Computer	18.00	20.43	13.50	16.30	20.71	29.17
Partner	4.50	7.17	16.83	11.38	11.80	6.11
difference	13.50	13.26	-3.33	4.92	9.91	13.06

Post-test 2 Mean Scores	Class 1*	Class 2	Class 3	Class 4	Class 5	Class 6
Computer	22.00	25.14	22.00	28.30	24.29	34.50
Partner	9.83	17.50	23.33	23.13	22.60	10.67
difference	12.17	7.64	-1.33	5.17	1.69	23.83

Post-test 3 Mean Scores	Class 1*	Class 2	Class 3	Class 4	Class 5	Class 6
Computer	25.00	**24.57**	28.25	**28.10**	28.14	**29.00**
Partner	**9.00**	26.17	27.83	**21.80**	26.60	16.44
difference	16.00	-1.60	0.42	6.30	1.54	12.56

Note. Bilingual class designated by the asterisk (*). Scores in bold face print show a slight decrease from second session.